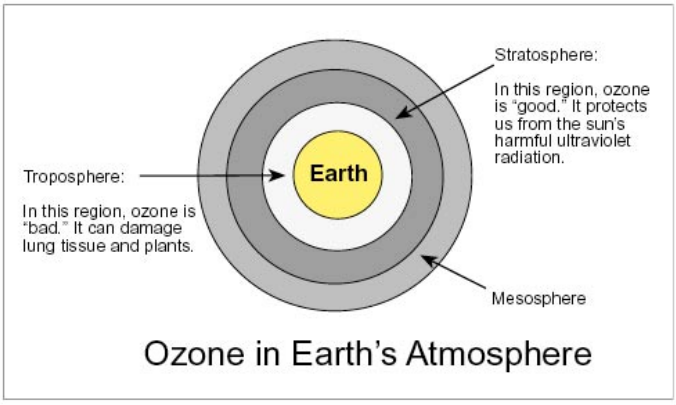
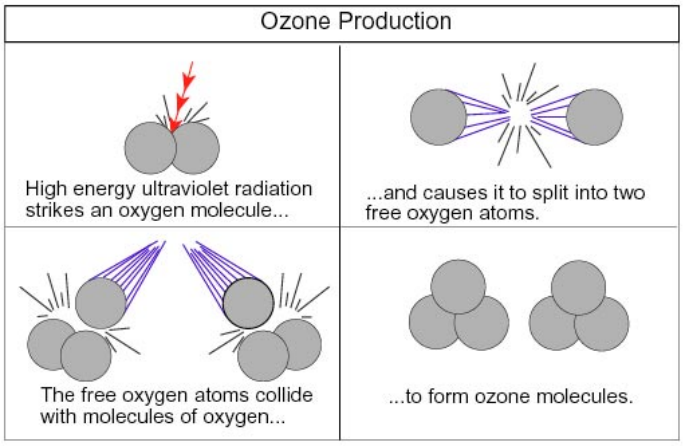
Ozone Reading



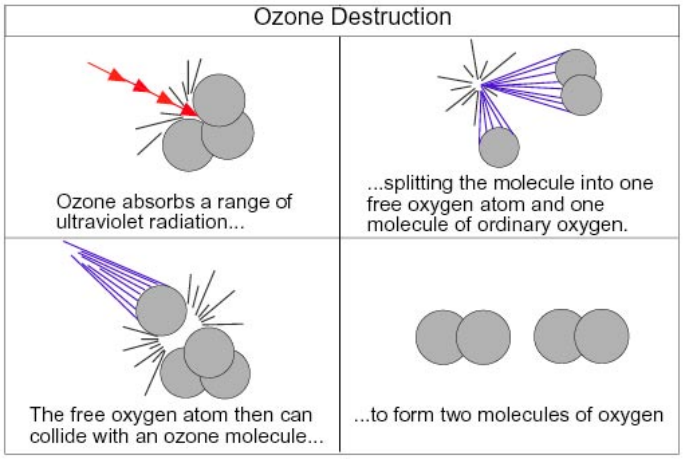
Ozone in Earth's Atmosphere

Ozone is a **molecule** made up of three atoms of **oxygen**. Most ozone is found in an area of Earth's **atmosphere** known as the **stratosphere**. Ozone is crucial for life on Earth. High in the atmosphere about 15 miles (24 km) up, ozone acts as a shield to protect Earth's surface from the sun's harmful **ultraviolet radiation**. Without this shield, we would be more vulnerable to skin cancer, cataracts, and impaired immune systems.

In the stratosphere, the air is bombarded with ultraviolet radiation from the sun. When those ultraviolet rays strike molecules of ordinary oxygen gas (O_2), they split the molecule into two single oxygen atoms. A freed oxygen atom then can bump into an oxygen molecule (O_2), and form a molecule of ozone (O_3).



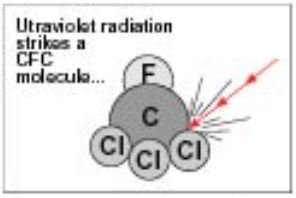
The characteristic of ozone that makes it so valuable to us--its ability to absorb ultraviolet rays--also causes its destruction. When an ozone molecule (O_3) absorbs ultraviolet radiation, it splits into an ordinary oxygen molecule (O_2) and a free oxygen atom (O). The free oxygen atom then may join up with an oxygen molecule to make another ozone molecule, or it may steal an oxygen atom from an ozone molecule to make two ordinary oxygen molecules.



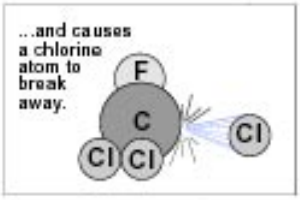
Over the Earth's lifetime, natural processes have kept the balance of ozone in the stratosphere. A simple way to understand the ozone balance is to think of a leaky bucket. As long as water is poured into the bucket at the same rate that water is leaking out, the amount of water in the bucket will remain the same. So, as long as ozone is being created at the same rate that it is being destroyed, the total amount of ozone will remain the same.

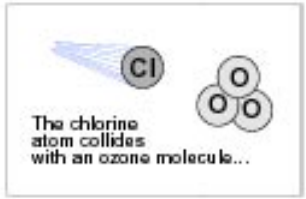
Scientists have found evidence that human activities are disrupting the ozone balance. Human production of chemicals such as **chloro-fluorocarbons** (CFCs) has added another force that destroys ozone. CFCs are molecules made up of chlorine, fluorine and carbon atoms bound together. One of the few things that can break up CFC molecules is ultraviolet radiation. In the lower atmosphere, however, CFCs are protected

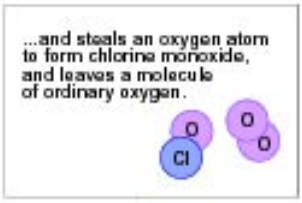
from ultraviolet radiation by the ozone layer. CFC molecules are able to migrate intact up into the stratosphere.



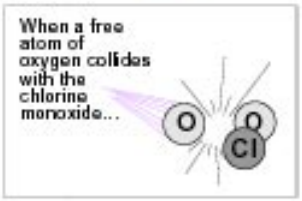
Once in the stratosphere the CFC molecules are no longer shielded from ultraviolet radiation by the ozone layer. Bombarded by the sun's ultraviolet energy, CFC molecules break up and release their chlorine atoms. The free chlorine atoms then can react with ozone molecules, taking one oxygen atom to form chlorine monoxide and leaving an ordinary oxygen molecule.

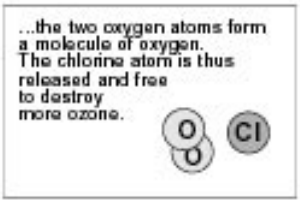






If each chlorine atom released from a CFC molecule destroyed only one ozone molecule, CFCs probably would pose very little threat to the ozone layer. However, when a chlorine monoxide molecule encounters a free atom of oxygen, the oxygen atom breaks up the chlorine monoxide, stealing the oxygen atom and releasing the chlorine atom back into the stratosphere to destroy more ozone. This reaction happens over and over again, allowing a single atom of chlorine to destroy many molecules of ozone. If humans stop putting CFCs into the stratosphere, the ozone layer may eventually repair itself.





Humans use CFCs in aerosol cans (in some countries), coolant in some refrigerators, and in the manufacturing of some plastics and foams. The percentage of human-produced CFCs are as follows:

Aerosols:	25%
Rigid Foam Insulation:	19%
Solvents:	19%
Air Conditioning:	12%
Refrigerants:	8%
Flexible Foam:	7%
Other:	10%

The term "**ozone depletion**" means more than just the natural destruction of ozone. It means that ozone loss is greater than ozone creation. Think again of the "leaky bucket." Putting additional chemicals like CFCs into the atmosphere is like causing the "bucket" of ozone to spring extra leaks. The extra leaks cause ozone to leak out at a faster rate--faster than ozone is being created. Consequently, the level of ozone protecting us from ultraviolet radiation decreases.

It is important to note that ozone, like oxygen, is a highly **reactive** element. It is so reactive that it is quite harmful when it comes into direct contact with life. In the stratosphere, ozone is a protector; on Earth's surface, it's a poison. Without it, though, life on Earth would be more difficult to maintain.

The text and graphics in this reading were adapted from the NASA Fact sheet NF-198 produced by the Earth Science Enterprise. The entire fact sheet can be found online at http://www.gsfc.nasa.gov/gsfc/service/gallery/fact_sheets/earthsci/eos/ozone.pdf